instructions

MONROE

ADDING-CALCULATOR

MA-7-W MODELS

OPERATING INSTRUCTIONS

Monroe Adding-Calculator

MA-7-W Models

When you have learned the few simple principles of Monroe operation you can apply it to any kind of figuring work.

MONROE CALCULATING MACHINE COMPANY, INC.

General Offices, Orange, New Jersey

Monroe Sales and Service are available in all principal cities

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Foreword

THIS book is designed to enable operators to use the Monroe Adding-Calculator to best advantage.

The directions are given in simplified form so they can be readily understood even by those who may never have used an adding or calculating machine. The book should enable them to add, subtract, multiply, and divide, and to work out all ordinary commercial problems without further assistance.

Part I consists of instructions for performing the fundamental operations of addition, subtraction, multiplication, and division, with rules for handling decimals.

Part II describes easy methods for shortening certain types of figuring work and outlines methods of doing typical, basic business problems.

Examples are given to show the wide adaptability of the Monroe Adding-Calculator and its effective application to modern office figuring. No attempt can be made in this comparatively small book to cover all of the many uses of the machine which can handle any kind of figuring problem no matter how complicated.

This book explains the use of MA 7-173-W and MA 7-213-W Monroe Adding-Calculators. Simple, more condensed instructions for the operation of these same models are available in a small leaflet, Form 853-S. More specific instructions for the application of MA-7-W Monroes to special types of figuring work will be furnished upon request.

Information about the most efficient methods of handling certain types of work and other assistance will be gladly given by the Monroe Company and its representatives. Anyone having questions or wishing personal instruction should get in touch with the nearest District or branch office of the Monroe Calculating Machine Company, Inc., or write to the General Offices at Orange, New Jersey.

MONROE OPERATION

For the easiest and most natural method of operating the Monroe Adding-Calculator, the general directions given below should be observed.

The machine is placed slightly to the right in front of the operator, turned at a slight angle to the right.

The keys on the keyboard are depressed by the fore and middle fingers of the right hand.

The right hand is also used to operate the plus and minus bars. For ease of operation, place the machine so that the forearm can rest on the desk when using the plus and minus bars for multiplication or division.

The fingers of the right hand also depress the carriage shift bars adjacent on the right to the plus and minus bars. A slight depression of these bars moves the carriage one position or if held down will shift the carriage any number of desired positions.

The fingers of the right hand can be used to clear the upper and lower dials and keyboard by depressing the clearance bars below the keyboard. Individual or multiple depression of these bars can be made as the requirements indicate.

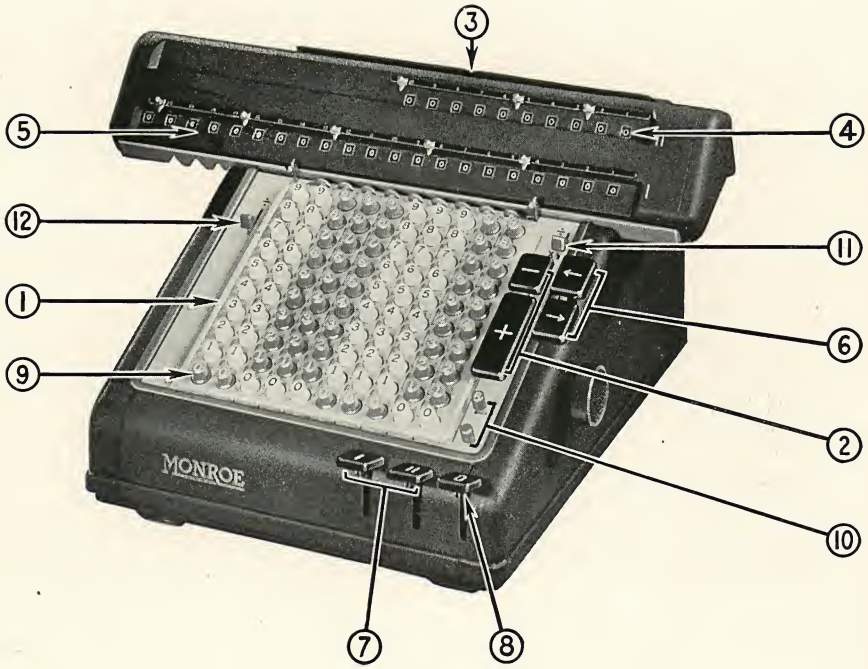

Figure 1

FEATURES

MA-7-W MODELS MONROE ADDING-CALCULATOR

1 Keyboard
2 Plus and Minus Bars
3 Carriage
4 Upper Dials
5 Lower Dials
6 Carriage Shift Bars
7 Clearance Bars for Dials
8 Keyboard Clearance Bar
9 Column Release or Zero Keys
10 Repeat and Non-Repeat Keys
11 Upper Dials Reversing Lever
12 Automatic Divide Lever

The model pictured here is the MA 7-213-W. Monroe Model MA 7-173-W has exactly the same features.

OPERATING INSTRUCTIONS

MONROE ADDING-CALCULATOR MA-7-W MODELS

PART I

VARIOUS PARTS OF THE MACHINE

OPERATION AND USE

The Monroe Adding-Calculator, as its name implies, is an adding and calculating machine capable of performing the four fundamentals of arithmetic, addition, subtraction, multiplication, and division with accuracy, speed, and simplicity.

The machine is designed with three principal functional parts: A standard keyboard (1 in Figure 1) for setting up the amounts to be added, subtracted, multiplied, or divided; the plus and minus bars (2 in Figure 1) located at the right of the keyboard, for performing the four fundamental arithmetical operations; and the carriage (3 in Figure 1) at the top of the machine in which are contained the dials which register the results and proofs of the various operations as they are performed.

All Monroe Adding-Calculators operate on the same basic principle; namely, a forward movement for addition and multiplication and a backward or reverse movement for subtraction and division. This is true regardless of whether machines are actuated by hand or motor power.

On MA-7-W models, which are entirely electric, addition and multiplication are accomplished by the use of the plus bar, subtraction and division by the use of the minus bar, or in the case of automatic division, by the use of the divide lever.

Since the principles of operation are basic for all Monroe models the fundamental part of these instructions can be used for any Monroe Adding-Calculator, even though they have been written for a specific type—the MA-7-W. For Monroe Adding-Calculators equipped with one set of upper dials containing black and red figures, or equipped with two sets of upper dials, special instruction books are available, Forms 809-S and 811-S respectively.

In the following descriptions of the parts of the Monroe the numerals refer to the key numbers in Figure 1.

1 Keyboard The Monroe keyboard is the standard, flexible type. By depressing the keys, which have been constructed with a "Velvet Touch," amounts to be added, subtracted, multiplied, or divided are set up. On all

models the depressed keys enable the operator to read amounts as they are set up. On MA-7-W models, as on all Monroes equipped with "Spot-Proof" keyboard, the depression of a key causes a shadow-ring to appear around it, further accentuating the depressed key. Thus an error is instantly detected after being set up and it can be corrected immediately by simply depressing the correct key, which automatically restores the key that has been incorrectly depressed in the same column.

2 Plus and Minus Bars The plus bar is depressed once for each amount to be added in addition. In multiplication it is held depressed until the machine makes the required number of revolutions and the multiplier is registered in the upper dials.

The minus bar is depressed once for each amount to be subtracted in subtraction. In division or subtractive multiplication this bar is held depressed until the required quotient figure or multiplier is registered in the dials.

3 Carriage The carriage can be moved to the right or left as required. The figures in the dials of the carriage are always in direct vertical alignment with the rows of keys on the keyboard; thus a depressed key in any column will register in the dial in the carriage which is in direct alignment with that row of keys.

4 Upper Dials The upper dials show the multiplier in multiplication as a basis for proving the calculation, and in division they show the quotient or result. On MA-7-W Monroes all results are in black figures. The upper dials are termed "true carry" dials because they have a ten-carry mechanism which registers a true count above 9 in any factor. They give a true reading of the multiplier in short-cut multiplication and also serve as an item counter in addition.

5 Lower Dials The lower dials register the result in addition and multiplication, the remainder in subtraction, and the dividend in division.

6 Carriage Shift Bars The carriage shift bars are located at the right of the plus and minus bars. Their operation is light and easy; when one is depressed the carriage is automatically shifted in the direction indicated by the arrow on that bar. The top shift bar is depressed to move the carriage to the left; the bottom shift bar, to move the carriage to the right.

7 Electric Clearance Bars for Dials The middle clearance bar, marked II, when depressed clears the upper dials automatically. The left clearance bar, marked I, clears the lower dials.

8 Keyboard Clearance Bar The right-hand bar at the lower corner of the keyboard is marked O and is used for three purposes. (a) The depression of this bar clears the keyboard. (b) A depression of this bar after automatic division, besides clearing the keyboard simultaneously restores the upper dials reversing lever to the × position. (c) Holding this bar down while keys are being depressed on the keyboard locks those keys from clearance, leaving the

balance of the keyboard free for setting up amounts not to be locked. To clear the locked part of the keyboard the non-repeat key is depressed and the plus bar depressed once; then when the dials are cleared the machine is ready for regular work.

The electric clearance bars for dials and the keyboard clearance bar may be depressed singly, in groups, or all three simultaneously. The latter operation clears the entire machine instantly.

9 Individual Column Release or Zero Keys The keys located immediately below the 1 key at the bottom of each row of keys and marked with an O, or zero, are used for clearing a depressed key in any column. By means of the zero key a figure incorrectly set up in any single column is cleared without clearing the entire keyboard.

10 Repeat and Non-Repeat Keys The red key marked "R" directly below the plus bar is the "R"epeat key. When it is depressed keys on the keyboard remain locked down until cleared by the operator. This "R"epeat key must be depressed for all multiplying and dividing operations.

The next red key directly below the "R"epeat is the non-repeat key. When this key is down the keyboard clears after each operation of the machine. On the MA-7-W if the non-repeat key is down and an automatic division is started, as soon as the automatic divide lever is pushed the repeat key is automatically depressed.

Depressing the "R"epeat key automatically raises the non-repeat key and depressing the non-repeat key automatically raises the "R"epeat key.

11 Upper Dials Reversing Lever or Change Lever When this lever is pushed forward into the ÷ position the direction of rotation of the upper dials is reversed.

In automatic division, when the divide lever is pushed the upper dials reversing lever automatically shifts to the ÷ position if it has been in the × position. Depression of the O bar directly following an automatic division restores the upper dials reversing lever to the × position. In order to secure true figure results in subtractive multiplication by minus bar operation and in semi-automatic division, the change lever should be manually placed in the ÷ position.

By raising the upper dials reversing or change lever it can be locked in either the × or the ÷ position. In automatic division, if negative results are desired this lever should be raised while in the × position thus disengaging it so that it is not automatically shifted with the divide lever. To restore it to normal automatic operation, push the lever down so that the red button is close to the case of the machine. This lever can also be raised and locked in the ÷ position when required to prevent its shifting when the keyboard clearance bar is depressed.

12 Automatic Divide Lever After a problem in division has been placed

on the machine and the carriage properly positioned for division, this lever is pushed into the upper position and the division is carried out automatically. Pushing the automatic divide lever also performs two other automatic operations simultaneously: it moves the upper dials reversing lever into the ÷ position (unless that lever has been locked in the × position previously), and it depresses the repeat key in case the non-repeat key happens to be down.

Decimal Markers Every Monroe Adding-Calculator has decimal markers on both dials and keyboard. These have no mechanical connection with the working parts of the machine, being used simply as a visual aid and guide to indicate the locations of decimal points. The markers are set in advance for the number of decimal places required for the work.

The decimal markers on the dials are fitted to metal strips on which they slide and they are moved to positions between dials to serve for pointing off the decimal points in figures. The markers on the keyboard are turned over by means of knurled knobs at the top. When one is turned over a red line between the rows of keys indicates the position of a decimal point on the keyboard.

FUNDAMENTAL OPERATIONS

ADDITION

Addition can be performed with the carriage in any position but it is recommended having it shifted to the left as far as it will go, which is called the "1" position. The numerical position of the carriage is determined by noting the small number on the decimal point marker strip of the lower dials and its alignment with the extreme right-hand row of keys over which there is a small red arrow called the carriage position pointer. If the small number 4 is in line with this pointer the carriage is said to be in the "4" position.

Addition is best accomplished by the "locked figure" method; that is, with the repeat key depressed.

Example $325 + 456 + 222 = 1003$

Method

Step 1—With the carriage in the "1" position set 325 on the extreme right of the keyboard. Depress plus bar once. The machine makes one revolution and the 325 appears automatically in the lower dials.

Step 2—Change keyboard set-up to 456. Depress the plus bar once. Automatically 456 is added to 325 and the result is in the lower dials.

Step 3—Change keyboard set-up to 222. Depress the plus bar once and the final result, 1003, appears in the lower dials as shown in Figure 2. As the upper dials of the MA-7-W act as an item counter, the figure 3 indicates that there have been that number of items added in this example.

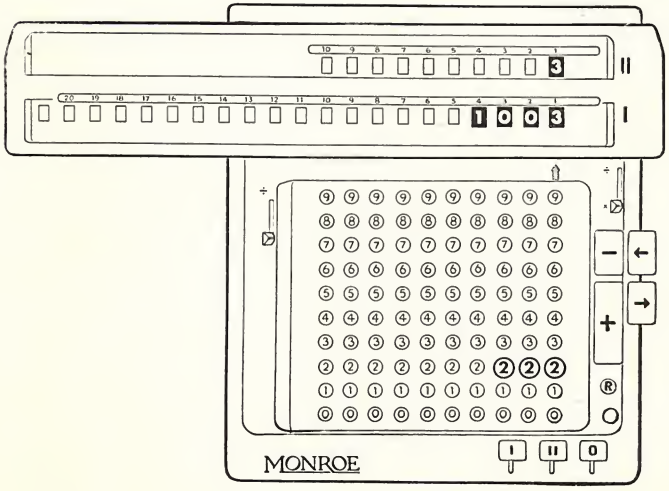

Figure 2

Step 4—Clear the dials and keyboard so that the machine is ready for the next figuring problem.

After the operator has had practice in setting amounts on the keyboard with the fore and middle fingers of the right hand, another method, called short-cut addition, can be followed. In this method both hands are used, the keys being depressed with the fore and middle fingers of each hand and the plus bar being depressed at the same time with the fourth or little finger of the right hand. This saves first depressing the keys and then depressing the plus bar as a separate operation. With short-cut addition each amount is registered in the dials the instant it is set on the keyboard.

SUBTRACTION

On the Monroe Adding-Calculator subtraction is a direct operation and is accomplished just as easily as addition.

Example $1003 - 325 = 678$

Method

Step 1—Set 1003 on the extreme right of keyboard. Depress the plus bar once. The larger amount is now added and appears in the lower dials.

Step 2—Change keyboard set-up to 325. Depress minus bar. The lower dials now show the remainder and final answer, 678, as in Figure 3.

Step 3—If proof of the addition of 1003 is desired, depress the plus bar again and the original amount added, 1003, appears in the lower dials.

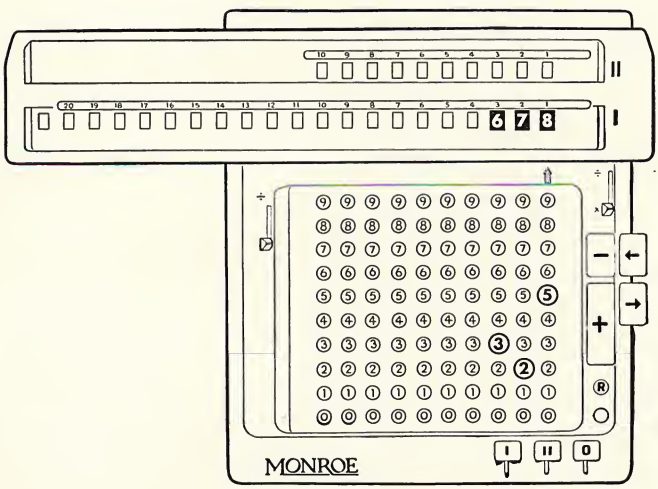

Figure 3

Subtraction can also be performed by reverse method, as follows:

Step 1—With the lower dials clear, set the smaller number, 325, on the keyboard and depress minus bar once. Disregard complementary figure in lower dials.

Step 2—Change keyboard set-up to 1003 and depress plus bar once. The lower dials now show the remainder, 678.

MULTIPLICATION

Multiplication is a series of repeated additions and is a simple process on the Monroe. It is accomplished by setting one amount on the keyboard and "writing" the other amount in the upper dials with the plus bar. In all operations of multiplication the repeat key must be depressed.

Example $789 \times 234 = 184626$

Method Change Lever at $\times$

Step 1—With the carriage in "1" position set 789 on extreme right of keyboard, as shown in Figure 4. Hold plus bar down until 4 appears in upper dials.

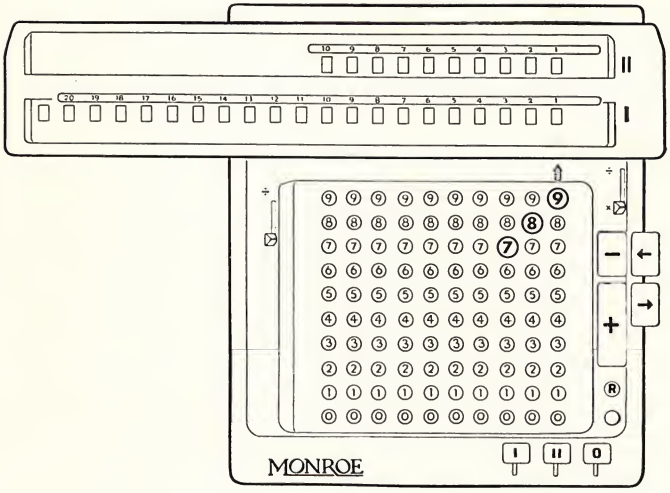

Figure 4

Step 2—With carriage shift bar, move carriage one place to the right. Depress plus bar until 3 appears to the left of the 4; then shift the carriage again one

place to the right and hold the plus bar down until 2 appears in the next upper dial.

Step 3—The machine now reads as in Figure 5: upper dials 234, the multiplier; keyboard (keys depressed) 789, the multiplicand; lower dials 184626, the result. This is complete and positive proof of accuracy. The only further proof required is a visual check of the 234 and the 789 in the machine against the two factors of the problem. If they agree the result must be correct.

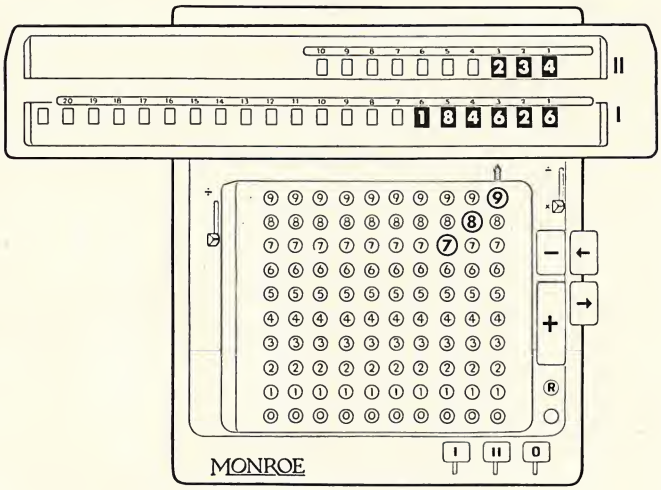

Figure 5

If the plus bar is held down too long in multiplication a number greater than that desired will appear in the dials. This is not a serious error because the higher figure can be reduced very quickly to the correct figure by depressing the minus bar. Similarly if a figure in the multiplier is found to be less than the required figure, the correction can be made by simply depressing the plus bar. Thus any error made by the operator in registering the multiplier in the machine can instantly be detected in the upper dials, and the correction made quickly and easily by using the plus or minus bar.

Changing the Multiplier

Correction of multipliers just described naturally leads to an explanation of problems requiring a constant multiplicand with changing multipliers.

At the completion of the previous problem (Figure 5), the machine reads 789 on the keyboard, 234 in the upper dials, and 184626, the result, in the lower dials. Supposing the 789 is a constant multiplicand and the operator

wishes to change the multiplier 234 to 432. Do not clear the machine. With carriage in the "3" position, add twice by depressing the plus bar, changing the 2 in the third upper dial to 4. By means of the carriage shift bar, move the carriage to the "1" position. Then with the minus bar change the 4 in the first upper dial to 2. The result in the lower dials is 340848, and the dials appear as in Figure 6.

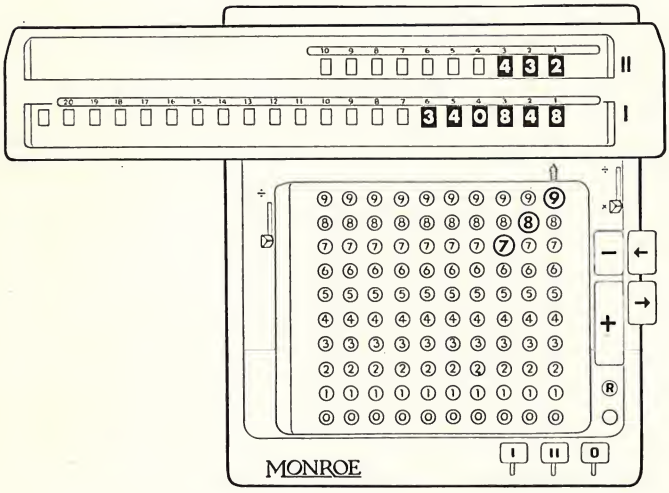

Figure 6

The entire operation is extremely simple. It requires no expert knowledge, skill, or training, and the result is absolutely accurate because all the figures used are visible in the machine.

Multiplication on the Monroe Adding-Calculator can be performed in either direction. For example, in the problem (789 × 234) given on page 13, the operator can begin as explained by multiplying first by the 4 units in the multiplier, shifting the carriage to the right to put in the 3 tens, and shifting again to register the 2 hundreds; or it can be performed by registering the 2 hundreds in the third position in the upper dials, shifting the carriage to the left and multiplying by 3 in the tens column, and shifting again to the left to multiply by 4 in the first or units column of the upper dials. The result will be the same in either case and as long as the multiplier agrees with the required figure the answer is sure to be correct. Note that as these operations are being performed the multiplier always registers in the upper dials directly over the carriage position pointer at the top of the keyboard.

DIVISION

Semi-Automatic Division

On the Monroe division is done with the same ease, simplicity, and directness as multiplication. As multiplication is a process of continued additions and is performed by the use of the plus bar, so division is a process of continued subtractions and as a semi-automatic operation it is accomplished by means of the minus bar.

Example 477591 ÷ 224 = 2132, remainder 23

Method Change Lever at ÷

Step 1—With the carriage in "1" position set the dividend, 477591 on the extreme right of the keyboard. Depress plus bar once. Clear keyboard and upper dials only.

Step 2—Set the divisor, 224, on the right of the keyboard and move the carriage three places to the right with carriage shift bar so that the divisor, 224, is in direct alignment with the 477, the first three figures of the dividend. The machine at this point appears as in Figure 7.

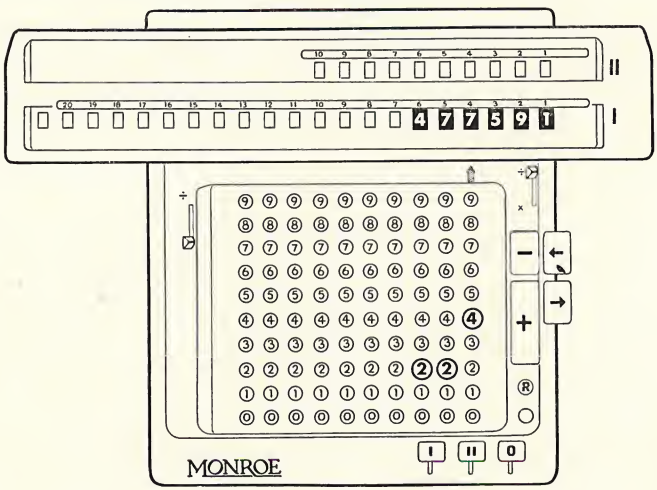

Figure 7

Step 3—Depress the minus bar until the machine stops, then depress the plus bar once. The 2 in the upper dials is the first figure of the quotient.

Step 4—Shift the carriage to the "3" position; hold the minus bar down until the machine stops and depress the plus bar once. The result in the third upper dial is 1.

Step 5—Continue this operation, shifting the carriage and depressing minus and plus bars. At the completion of the problem (Figure 8), the quotient, 2132, appears in the upper dials and the remainder, 23, is in the lower dials.

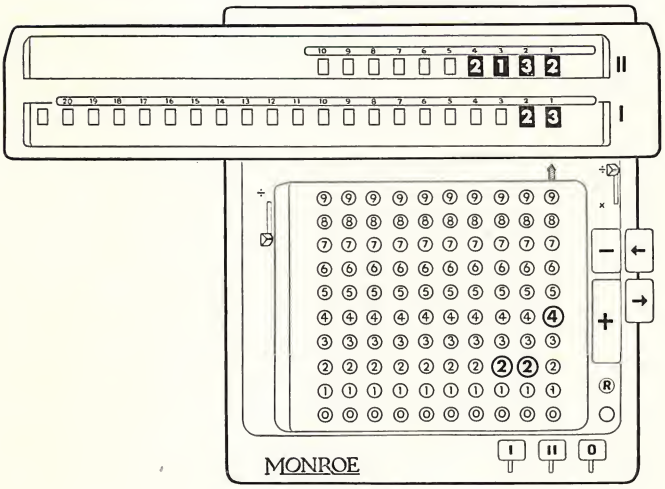

Figure 8

At the end of each step in this division problem the figures in the dials of the Monroe are as follows:

	1st Step	*2nd Step*	*3rd Step*	*4th Step*
Upper Dials	0000002000	0000002100	0000002130	0000002132
Lower Dials	0000029591	0000007191	0000000471	0000000023
Keyboard	0000000224	0000000224	0000000224	0000000224

Automatic Division

Since MA-7-W Monroes are equipped with automatic division, most division operations should be performed by using the automatic divide lever rather than performing the work semi-automatically by means of the minus bar method just described.

Example Same as preceding problem: 477591 ÷ 224 = 2132, remainder 23

Method Change Lever automatically shifts into divide position

Steps 1 and 2—These steps are exactly the same as Steps 1 and 2 in the preceding instructions for semi-automatic division.

Step 3—Push the divide lever and while the machine is dividing copy the figures of the quotient, 2132, as they appear in the upper dials. Clear the entire machine by depressing dials clearance bars and keyboard clearance bar; it will be noted that depression of the keyboard clearance bar automatically restores the upper dials reversing or change lever to the × position.

Note that in automatic division Steps 3, 4, and 5 of the semi-automatic method are eliminated. When the divide lever is pushed the carriage is shifted and the result secured automatically. Also note that in automatic division it is unnecessary to shift the upper dials reversing lever manually to the ÷ position. If it is in the × position pushing the divide lever simultaneously shifts the upper dials reversing or change lever.

Monroe automatic division is easy and fast, particularly because the quotients are written while the machine is operating.

DECIMALS

Rules for Pointing Off

On all calculating machines fractions are expressed as decimals.

$$1/4 = .25 \quad 5/8 = .625 \quad 11/16 = .6875$$

The arrangement of the dials and the keyboard of the Monroe Adding-Calculator makes it particularly well adapted to the handling of calculations involving decimals. The fact that the Monroe shows all three factors of a calculation and that the dials are always in direct alignment with the rows of keys makes possible a decimal set-up for the entire problem which guarantees accurate decimal points in the result.

Fixed Decimal Points

It is possible on a calculator to set decimal points for each individual problem regardless of the variations in number of decimal places. On the Monroe, however, the use of the fixed decimal point method is simpler, saves time, and insures accuracy.

In this method of fixed decimal points it is necessary, first, to determine from the work to be done the greatest number of decimal places which will be required for both the multiplier and the multiplicand. The sum of these two figures will be the number of decimal places in the result. For example, if four decimal places are the maximum requirement for the multiplier and five decimal places are required for the multiplicand, the result will require nine decimal places, because $4 + 5 = 9$. This simple principle can be expressed as a formula in terms of machine parts.

Monroe Formula for Decimals

Since the multiplicand is set on the keyboard with the multiplier appearing in the upper dials and the result in the lower dials, the Monroe system of decimal point set-up is expressed as the following simple formula:

Upper Dials + Keyboard = Lower Dials

Note how directly this formula applies to the ordinary arithmetical rule for handling decimals; that is, point off as many places in the result as there are decimal places in the other two factors combined.

Multiplication of Decimals

An examination of the following problem which illustrates the fixed decimal point principle shows the maximum number of decimal places required to be: upper dials 3, keyboard 3, lower dials 6.

Example $20.125 \times .425 = 8.553125$

Method

Decimals: Upper Dials 3
Keyboard 3
Lower Dials 6
Change Lever at $\times$

Step 1—As the larger number, 20.125, will be set on the keyboard, turn over decimal marker at 3. Set 20.125 on right of keyboard.

Step 2—Move upper dials decimal marker to 3 and lower dials marker to 6. Starting with carriage in "1" position, multiply successively with the plus bar by 5, 2, and 4, shifting the carriage for each digit.

Step 3—The result in the lower dials will be 8.553125, correctly pointed off (Figure 9). If the result is dollars and cents it is copied from the lower dials as $8.55, ignoring the terminal digits 3125. If these digits were 5125 instead of 3125 the half-cent would be picked up and the amount would be $8.56 instead of $8.55.

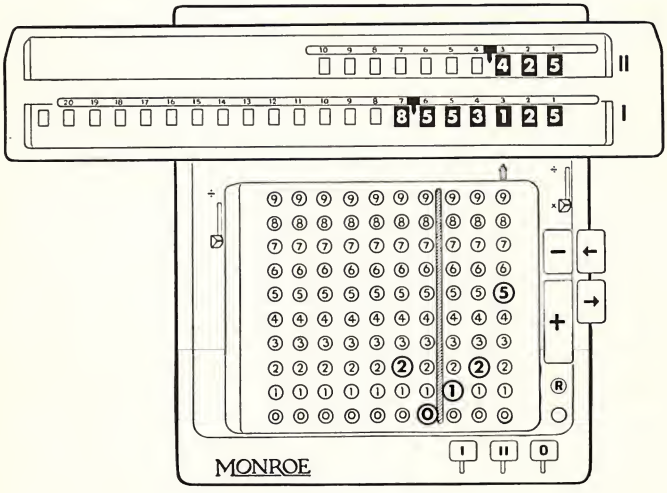

Figure 9

In the next problem the maximum decimal points of the previous example will not be entirely used.

Example $24.75 \times .35 = 8.6625$

Method

Decimals: Upper Dials 3
Keyboard 3
Lower Dials 6
Change Lever at $\times$

Step 1—The larger amount, or multiplicand, is 24.75. The keyboard fixed decimal point is at 3, so when 24.75 is set on the keyboard it appears as 24.750.

Step 2—The upper dials fixed decimal point is at 3, so .35 is "written" in the upper dials by means of the plus bar as .350. This is done by starting the multiplication with the carriage in the "2" position instead of the "1" position.

Step 3—After multiplying by .35 the result appears in the lower dials, 8.662500, correctly pointed off (Figure 10).

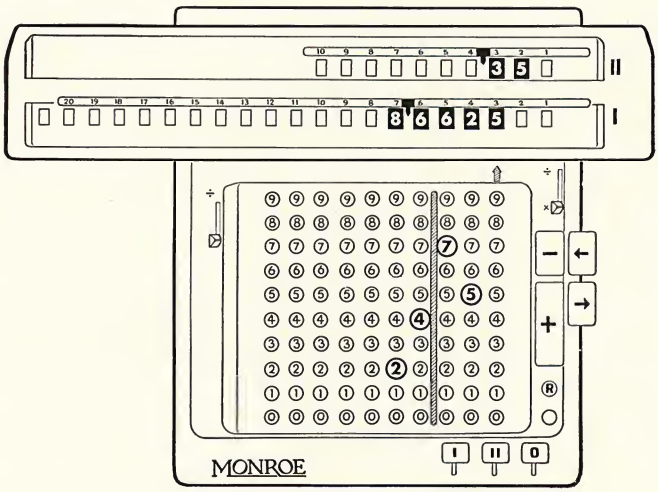

Figure 10

In this example the ciphers to the right of the significant figures in all three factors are those parts of the fixed decimals that were not used. In the upper dials on the right of the multiplier there is one cipher; on the keyboard one cipher; in the lower dials two ciphers. This is still according to the Monroe formula. The actual problem required $2 + 2 = 4$ decimals; the fixed decimal set-up was $3 + 3 = 6$. Therefore $2 + 2 = 4$ decimals plus $1 + 1 = 2$ ciphers is equal to the fixed decimal set-up, $3 + 3 = 6$.

Division with Decimals

In division the same principle of pointing off decimals applies; that is, the sum of the decimal places in the upper dials and the keyboard must equal the number pointed off in the lower dials.

Example $22.868 \div 6.7 = 3.4131$

Method

Decimals: Upper Dials 4
Keyboard 3
Lower Dials 7

Step 1—The quotient is to be carried out to three decimal places. Since the quotient will be shown in the upper dials start by fixing the decimal marker in those dials. Always set a decimal marker at one more place than actually required in the quotient in order that the answer may be accurately adjusted. Therefore $3 + 1 = 4$ places in the upper dials.

Step 2—To provide for the three decimal places in the dividend, turn over a keyboard marker at 3, even though in this particular problem the divisor has only one decimal place.

Step 3—The keyboard and the upper dials decimal points are now set at 3 and 4 respectively. Therefore, the decimal point in the lower dials is set at 7 in accordance with the Monroe formula: $3 + 4 = 7$.

Step 4—Set the dividend, 22.868, on the keyboard and shift the carriage to the "5" position so that the 22.868 will appear in the lower dials correctly pointed off at the 7th decimal place.

Step 5—Depress the plus bar to add 22.868 into the lower dials. In registering a dividend in the lower dials a 1 appears in the upper dials. Always clear this 1 and the keyboard by depressing the two right-hand clearance bars, II and O.

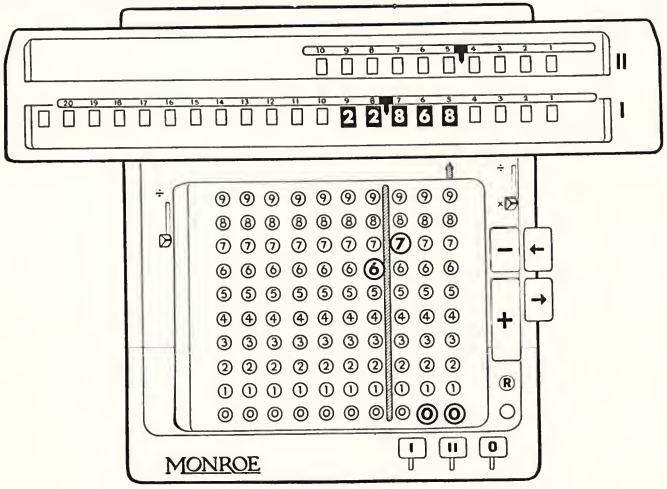

Figure 11

Step 6—Set 6.7 on the keyboard so that it appears as 6.700. With the carriage in "5" position push divide lever (Figure 11).

Step 7—The result, 3.4131, appears in the upper dials in correct position with relation to the decimal point which was previously set. (Figure 12). The .0002300 in the lower dials is the remainder. Clear entire machine; as the keyboard is cleared the shift lever returns to the × position.

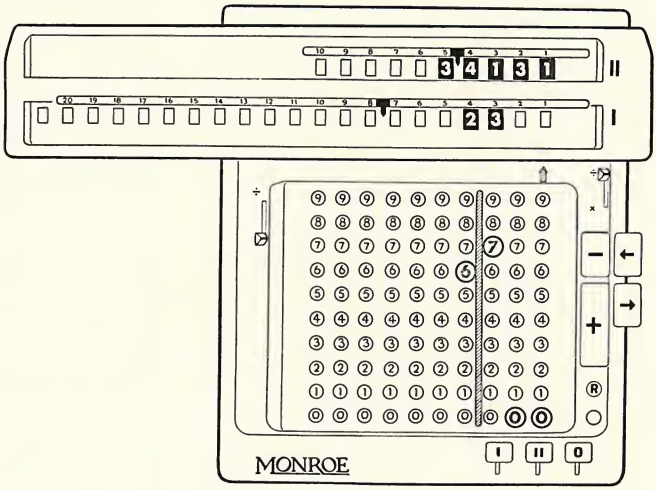

Figure 12

Following is another illustration of division with decimals.

Example $20.621 \div 6.41356 = 3.21522$

Method

Decimals: Upper Dials 6
Keyboard 5
Lower Dials 11

Step 1—The quotient in this example is to be carried out five decimal places. Therefore, the upper dials decimal marker is set at 6, one more than the required five.

Step 2—Since the divisor has five decimal places, turn the keyboard marker over at 5. This makes it necessary to set the lower dials decimal marker at 11, because $6 + 5 = 11$.

Step 3—Set 20.621 on the keyboard as 20.62100, and with the carriage in the "7" position add it into the lower dials.

Step 4—Clear the keyboard and upper dials with the two right-hand clearance bars. Set 6.41356 on the keyboard. Carriage is already in "7" position ready for the division, as pictured in Figure 13.

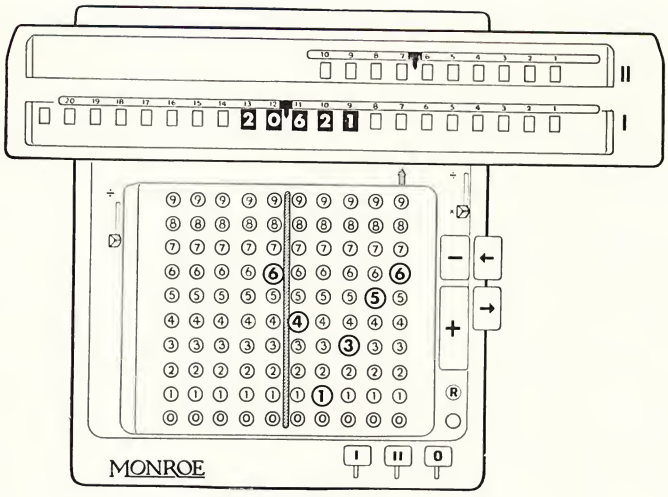

Figure 13

Step 5—Push automatic divide lever. The final result will appear as in Figure 14.

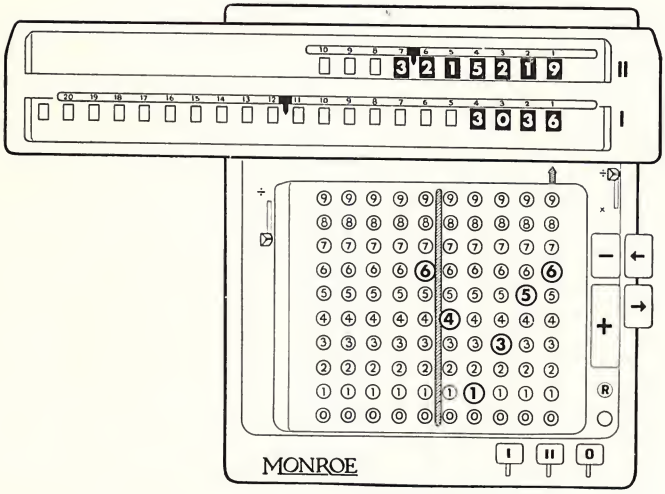

Figure 14

The example of Figure 14 illustrates the advantage of setting the upper dials decimal marker at one place more than the number of places required for the quotient. In the first upper dial or in the sixth decimal place is a 9. Therefore, the quotient should be read as 3.21522 and not 3.21521, which would have been the incomplete quotient if the upper dials decimal had been set at five places instead of at six.

PART II

SPECIAL APPLICATIONS

As the Monroe performs the four fundamental processes of arithmetic so readily it can be applied to any kind of figuring. Moreover, its flexibility makes possible numerous short-cuts which greatly simplify work and save time. Some of these are explained in this book.

Every operator of the Monroe should understand how to use the machine for the usual types of business work and should be familiar with the short-cutting methods and applications for certain jobs. A few that are especially useful because their principles can be adapted to the figuring common to many lines of business are described here.

Special figuring problems can often be worked out by the operator without difficulty. Assistance will be rendered by a representative of any local Monroe office who will give personal instruction or devise the most efficient machine method for any particular piece of work. Such service can also be requested by writing to the General Offices of the Monroe Calculating Machine Company, Inc., in Orange, New Jersey, where a special department is maintained for this purpose.

SOME SHORT-CUT OPERATIONS

Correction of Lower Dials Amount

If, after an item has been added into the lower dials, the operator notices that one or more of the figures are incorrect, it is not necessary to clear the machine provided the addition was performed with the repeat key depressed. Leaving the incorrect amount on the keyboard, the minus bar is depressed which clears the figures from the lower dials. Then the keyboard set-up is changed to the correct amount and the plus bar depressed.

Transferring Amounts from Lower Dials

Frequently it is necessary to copy an amount that is in the lower dials to the keyboard. An easy and fast way to prove that the transfer has been made correctly is to align the lower dials and keyboard and then depress the minus bar.

If the correct transfer has been made the lower dials clear, all registering zero. However, if any figures appear in the lower dials after the subtraction, it immediately shows that a mistake has been made in copying. To correct the error, depress the plus bar, again restoring the original amount to the lower dials and then correct the keyboard set-up.

Negative Subtraction

Often the amount in the lower dials is the total of a series of additions or the result of a multiplication which is to be subtracted from a larger amount.

Instead of noting this result on paper, clearing the dials, and adding the larger amount in the machine, and then subtracting from it the amount noted on paper, follow this procedure to save time and insure accuracy:

Copy the result of the addition or multiplication to the keyboard. Depress the minus bar once. If the lower dials clear to zeros the amount copied to the keyboard is correct. Then depress the minus bar once again. The lower dials now show the complement of the first amount which is on the keyboard. Change the keyboard to read the second or larger amount. Depress the plus bar once and the result of the subtraction will appear in the lower dials.

Reading Negative Answers

It sometimes happens that when adding and subtracting a number of items for a net result that result is termed "negative" because the total of the minus items is a larger figure than the total of the plus amounts.

The lower dials of the machine show a row of 9's to the left of an amount which is actually the complement of the desired net result. It is necessary to know the positive reading for this negative result. The process is very easy.

Copy to the keyboard the entire negative result just as it appears in the lower dials, including enough 9's at the left to fill the keyboard. Be sure each figure copied to the keyboard is in direct alignment with the lower dial containing that figure. Subtract twice with the minus bar and the lower dials will show the positive reading of the negative result.

Short-cut Multiplication

When a multiplier is an amount with 7's, 8's, or 9's (as for example 39, 198, 997) the multiplication may be accomplished by a combined use of the plus and minus bars, reducing considerably the number of revolutions required by the regular method.

Example $2146 \times 198 = 424908$

Method

Step 1—Set 2146 on right of keyboard. Shift the carriage to the "3" position. Multiply with the plus bar by 2, the equivalent of 200.

Step 2—Then shift the carriage to the left two places so that it is in the "1" position. With the minus bar subtract twice. The answer, 424908, appears in the lower dials. In the upper dials are the true figures of the multiplier, 198. See Figure 15.

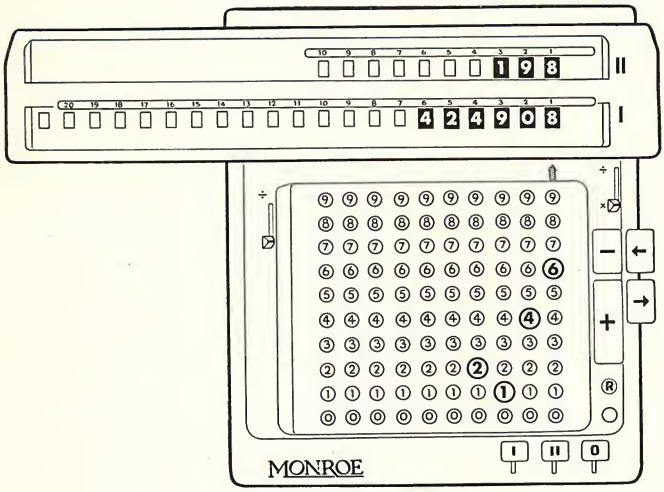

Figure 15

Performing this problem by short-cut multiplication took only four revolutions of the machine, whereas the other method of multiplication would require eighteen revolutions.

The operator should practice this method of shortening all multiplications. For example, instead of multiplying by 88, multiply by 100 and take off 12. Instead of multiplying by 2192 multiply in the "4" carriage position by 2, then by 2 in the "3" position, then reversely by 1 in the "2" position, and finally by 2 in the "1" position.

A little practice will enable the operator to become proficient in speeding up all multiplications by using short-cuts such as these:

Multiplier		*Revolutions*				*Revolutions Saved*
283	=		+3	−2	+3	5
408	=		+4	+1	−2	5
827	=	+1	−2	+3	−3	8
2791	=	+3	−2	−1	+1	12
5987	=	+6	0	−1	−3	19

Accumulative Multiplication

The accumulated result of a series of multiplications can be obtained on the Monroe by making one multiplication after another without clearing the lower dials after each multiplication.

Example

29 articles	@	$ .49 each	= $ 14.21
41 articles	@	2.25 each	= 92.25
58 articles	@	1.89 each	= 109.62
3 articles	@	4.01 each	= 12.03
		Total Cost	$228.11

Method

Decimals: Upper Dials 0
Keyboard 2
Lower Dials 2
Change Lever at ×

Step 1—With carriage in "2" position set .49 on extreme right of keyboard. Multiply by 29, using short-cut operation (30 − 1). The result, 14.21, appears in lower dials. Clear upper dials only.

Step 2—Next set 2.25 on right of keyboard. Multiply by 41. Visually check the multiplier in the upper dials and the multiplicand on the keyboard. The lower dials show 106.46, the accumulation of 14.21 and 92.25. Clear upper dials only.

Step 3—Continue in the same way for the other extensions, in each case clearing only the upper dials. After completing the last extension the lower dials show 228.11, checking the total of the invoice. Figure 16.

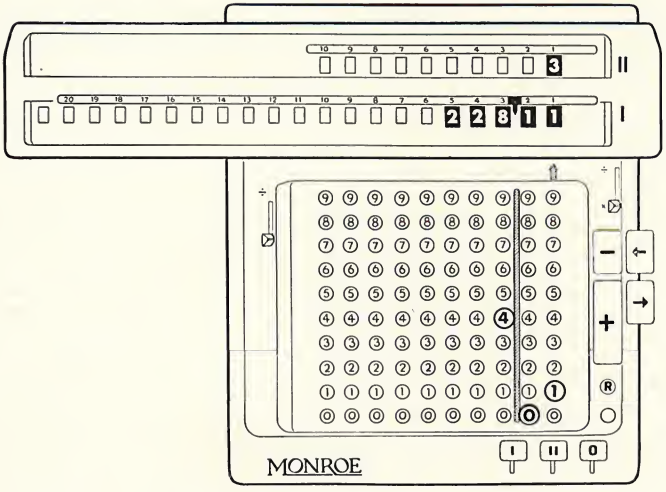

Figure 16

Constant Multiplication Short-cuts

Because the upper dials of the Monroe MA-7-W have the carry-over feature, convenient short-cuts are made possible in constant multiplication. The constant factor is set on the keyboard and the plus and minus bars are used to change the multipliers in the upper dials.

Example

$$355 \times 85 = 30175$$
$$355 \times 115 = 40825$$
$$355 \times 995 = 353225$$

Method

Decimals: None
Change Lever at $\times$

Step 1—With the carriage in "1" position set 355 on right of keyboard. Multiply by 85, and the result of the first extension, 30175, appears in the lower dials. Clear nothing.

Step 2—With the carriage in the "2" position hold the plus bar down until the 8 in the upper dials is changed to 11. Result in lower dials is 40825. This same figure could have been secured by reducing the 8 to 1 with the minus bar and then using the plus bar to register a 1 in the third upper dial. The operation would have taken 8 strokes but by short-cutting only 3 strokes were needed. Do not clear machine.

Step 3—With the carriage still in the "2" position, depress minus bar twice; the upper dials read 95. Then move the carriage to the "3" position and depress minus bar once; move carriage to "4" position and depress plus bar once. The upper dials read 995 and the lower dials 353225, the result. Using this short-cut method took just four revolutions of the machine whereas the longer way with the plus bar would have required sixteen.

DISCOUNTS

Subtractive Multiplication

Example 456 lbs. copper @ \$.22½ lb. less 12½% = \$89.78

Method

Decimals: Upper Dials 3
Keyboard 3
Lower Dials 6
Change Lever at $\times$

Step 1—Set 456.000 on the keyboard. Starting with the carriage in the "1" position, multiply by .225. Lower dials show gross amount of invoice, 102.60.

Step 2—Clear keyboard and upper dials only. Leaving the carriage in "3" position copy the amount in the lower dials, 102.60, to the keyboard. Shift change lever into $\div$ position.

Step 3—With minus bar multiply by 1. Then move carriage one place to the left and with minus bar multiply by 2. Shift carriage again to the left and with minus bar multiply by 5.

Step 4—Upper dials show .125, rate of discount; lower dials 89.775000 or $89.78, net of invoice; and keyboard 102.60, gross invoice. See Figure 17.

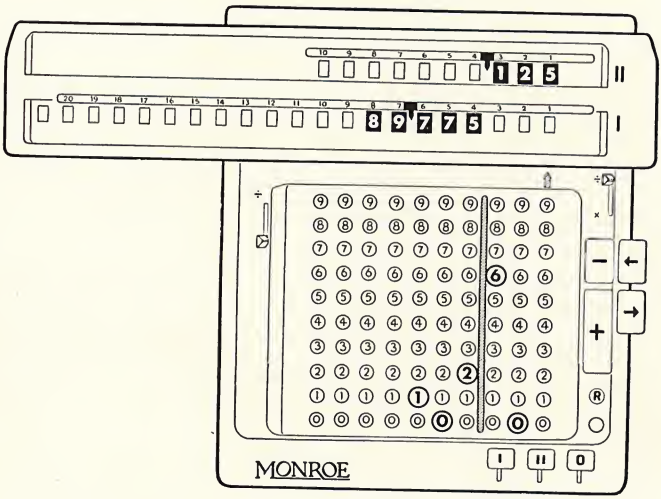

Figure 17

This process of taking off a discount is in reality a combination of subtraction and multiplication performed simultaneously.

If after Step 4 it is desired to obtain the amount of the discount, clear the lower dials only and with the plus bar multiply by figures in the upper dials. The discount amount, 12.83, appears in the lower dials and the upper dials are cleared to zero as proof of the multiplication.

Chain Discounts

A chain discount is a series of separate discounts that are taken off one gross amount.

The method just described can be adapted to figuring a chain discount. After the first discount has been subtracted, the net amount in the lower dials of the machine becomes the new gross for the next discount. It is copied to the keyboard and the upper dials are cleared; then the second discount is figured and subtracted as was the first. If a third discount is required the second net amount becomes the new gross and is likewise copied to the keyboard and the deduction figured at the third discount rate in the same way.

If, however, many problems involving chain discounting are to be figured, the work can be considerably shortened by using a special table of discount factors which is published and furnished free by the Monroe Company.

Use of Chain Discount Table

The Monroe Table for Chain Discounts (Form 120-S) shows the decimal equivalents for many of the most commonly used chains. By multiplying one of these equivalents by the gross amount the net amount is figured in one calculation. For example, the "off" equivalent of 50-10-5% is .5725 and the equivalent for this chain on the table is 100% less .5725 or .4275. Therefore if the gross amount is 102.60 less 50-10-5%, multiplying 102.60 by .4275 gives the net, 43.86.

Example List price $6.50 less 50-10-10-5%. Find the net price.

Method

Decimals: Upper Dials 2
Keyboard 5
Lower Dials 7
Change Lever at ×

Step 1—First, the equivalent for 50-10-10-5% is found on the Monroe Table of Chain Discounts (Form 120-S). It is .38475, which is set on the keyboard.

Step 2—Starting with the carriage in the "2" position, the equivalent is multiplied by 6.50. The result in the lower dials is 2.5008750, or 2.50, the net price. (Figure 18.)

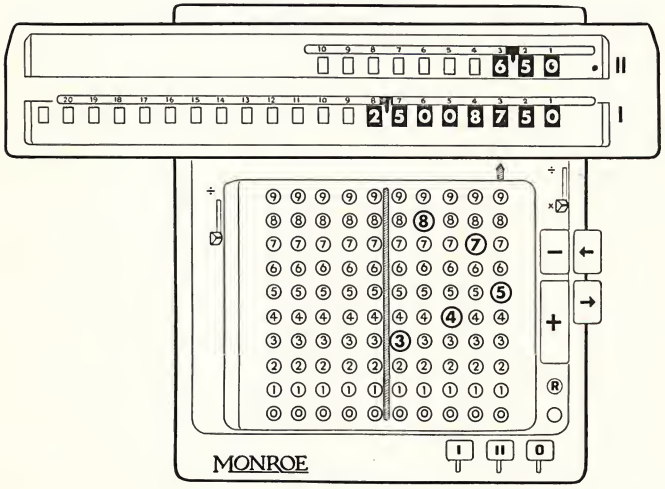

Figure 18

PERCENTAGE

In all percentage calculations a percentage is written on the machine as a decimal; for example, 35% is .35; 4½% is .045; 5¼% is .0525, etc.

Straight percentage work can be either the multiplication of an amount of money by a percentage figure to arrive at another amount; or it can be the division of one amount by another to secure a percentage.

The several examples shown to illustrate percentage use a fixed decimal set-up which will take care of both the multiplication and the division problems.

Multiplication by a Per cent

Example

35% of $ 47.65 = $16.68
4½% of 55.00 = 2.48
5¼% of 356.75 = 18.73

Method

Decimals: Upper Dials 5
Keyboard 2
Lower Dials 7
Change Lever at ×

In each of these examples the amount of money is set on the keyboard and multiplied by the per cent expressed as a decimal. Results appear in the Monroe as follow:

Keyboard		*Upper Dials*		*Lower Dials*
47.65	×	.35000	=	16.6775000
55.00	×	.04500	=	2.4750000
356.75	×	.05250	=	18.7293750

Division to Secure a Per cent

Example

What % of 355.25 is 275.85? Answer 77.65%
What % of 256.75 is 325.45? Answer 126.76%
What % of 175.45 is 12.85? Answer 7.32%

Method

Decimals: Same as in previous example
Change Lever at ×

It will be noted that in each of these percentage problems there is an amount which is immediately preceded by the word "of."

The rule for figuring what per cent one amount is of another is that the divisor is always the "of" amount or the amount preceded by the word "of."

Following the rule and using the "of" figures as divisors, these problems are calculated on the Monroe as follows:

Lower Dials Dividend		*Keyboard Divisor*		*Upper Dials Quotient*
275.8500000	÷	355.25	=	.77649
325.4500000	÷	256.75	=	1.26757
12.8500000	÷	175.45	=	.07324

Use of Percentages

Percentages are used in business generally for the purpose of making comparisons of amounts; one amount being taken as a standard of 100% and the other amounts being converted on this basis to a percentage figure, the percentage showing the ratio of difference between the amounts. In determining increases or decreases in amounts of sales, expenses, profits, etc., the relation of one amount to another is more readily comprehended when comparisons are made by means of percentage figures.

The following examples illustrate the application of the Monroe Adding-Calculator to variations in this type of figuring work common to modern accounting and statistics.

Increase and Percentage of Increase

In this problem the amount of increase as well as the percentage of increase is desired.

Example Find increase and percentage of increase that $2963.40 is of $1582.61

Increase	*Per cent Increase*
$1380.79	87.25

Method

Decimals: Same as in previous example
Change Lever at ×

Step 1—With the carriage in the "6" position set 2963.40 on the right of the keyboard and depress the plus bar once.

Step 2—Change keyboard set-up to 1582.61. Depress minus bar once. The amount of increase, 1380.79, appears in the lower dials as shown in Figure 19.

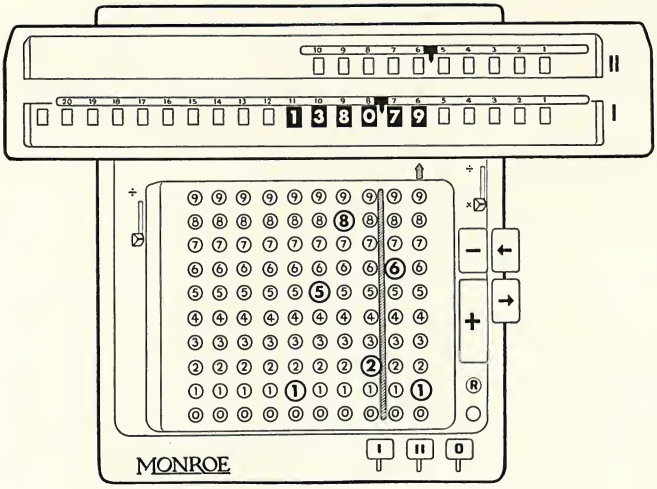

Figure 19

Step 3—Now the percentage of increase is figured. Shift the carriage one place to the left and divide the amount in the lower dials by the amount on the keyboard, pushing the automatic divide lever. The percentage of increase appears in the upper dials, .87247 or 87.25% (Figure 20).

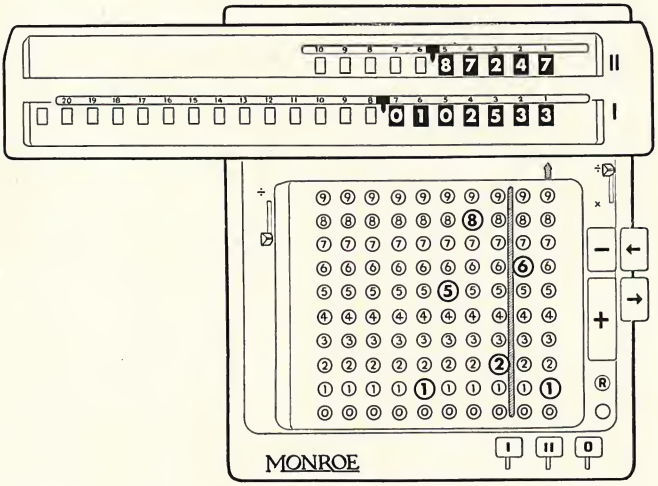

Figure 20

Decrease and Percentage of Decrease

In the next problem the amount of the decrease as well as the percentage of decrease is to be figured.

Example Find decrease and percentage of decrease that $1568.05 is of $2731.65

Decrease	*Per cent Decrease*
$1163.60	42.60

Method

Decimals: Same as in previous example
Change Lever at ×

Step 1—With carriage in "6" position set 1568.05 on the right of the keyboard. Depress minus bar once. The lower dials then read 99999998431.95.

Step 2—Change keyboard set-up to 2731.65. Depress plus bar once. The amount of the decrease, 1163.60, appears in the lower dials as illustrated in Figure 21.

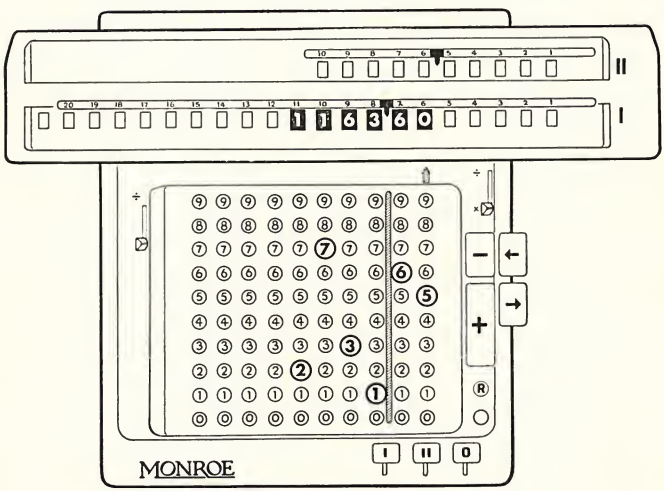

Figure 21

Step 3—Without clearing dials or keyboard push automatic divide lever. The result in the upper dials, .42596, is the percentage of decrease, 42.60%.

Percentage of Increase, Percentage Only

If the percentage of increase only is required, the subtraction operation is eliminated.

Example Find the percentage of increase that this year is of last year.

Last Year	*This Year*	*Per cent Increase*
$369.64	$435.75	17.89

Method

Decimals: Same as in previous example
Change Lever at ×

Step 1—In this method this year's figure is always set on the keyboard first. Accordingly set up 435.75 and with the carriage in the "6" position register it in the lower dials by depressing the plus bar once. Depress II and O clearance bars, thus clearing upper dials and keyboard.

Step 2—Set 369.64 on the right of the keyboard. Push divide lever which automatically shifts change lever to ÷ position. The result in the upper dials, .17884 or 17.88%, is an increase because it is preceded by a 1. Clear entire machine which automatically restores the change lever to × position.

Percentage of Decrease, Percentage Only

If the percentage of decrease only is required, the subtraction operation is eliminated.

Example Find the percentage of decrease that this year is of last year.

Last Year	*This Year*	*Per cent Decrease*
$2361.50	$1257.65	46.74

Method

Decimals: Same as in previous example
Change Lever at ×, raised into locked position

Step 1—Again this year's figure, for this example 1257.65, is set on the keyboard and with the carriage in the "6" position register it in the lower dials by depressing the plus bar once. Clear upper dials and keyboard only.

Step 2—Set 2361.50 on the right of the keyboard. Push divide lever (it will be noted that the change lever does not shift). The upper dials result, .46744 or 46.74%, is a decrease because it is preceded by 9's. Clear entire machine and push down the change lever if the next percentage to be figured is an increase.

Finding Per cent of Mark-up on Retail

Department and retail stores generally figure per cent of mark-up or difference between cost and selling price using the retail as a base rather than the cost.

Example Cost price $24.50 Selling price $43.75
Per cent of mark-up on retail 44%

Method

Decimals: Upper Dials 3
Keyboard 2
Lower Dials 5
Change Lever at ×,
raised into locked position

Step 1—With carriage in the "4" position set 24.50 on right of keyboard. Depress plus bar once. Clear nothing.

Step 2—Change keyboard set-up to 43.75. Push divide lever. (Change lever does not shift.) Upper dials result, .440 is 44% mark-up on retail.

LOCKED-FIGURE DIVISION
with Split-locked Keyboard for Percentage Work

To save resetting a constant factor it is possible to lock the figures on the keyboard by holding the O clearance bar depressed while the constant is being set up. This does not lock the remaining rows of keys which are available for setting up amounts that are not constant. The Monroe locked-figure feature has many advantages and is particularly useful when a constant divisor is used, as illustrated by the following percentage problem.

Example

Branch	*Sales*	*Per cent*
A	683	13.64
B	295	5.90
C	1780	35.57
D	2246	44.89
Total	5004	100.00

Method

Decimals: Upper Dials 4-2
Keyboard 4
Lower Dials 4
Change Lever at ÷,
raised into locked position

Step 1—With carriage in "1" position, lock 5004 on right of keyboard by holding down the right-hand O clearance bar while set-up is being made.

Step 2—Set 683 on the keyboard at left of 4th decimal. Depress plus bar once.

Step 3—Depress O clearance bar and lower carriage shift bar simultaneously,

shifting the carriage into the 4th position. When the keyboard clearance bar is depressed the change lever does not shift because it has been locked by being raised. The machine is now as pictured in Figure 22. Disregard the 9's in the upper dials but do not clear them.

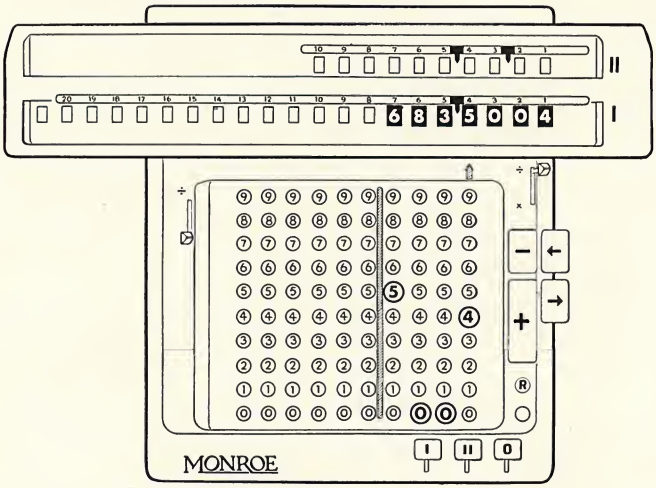

Figure 22

Step 4—Push automatic divide lever and the upper dials result, 13.64, is the first percentage. Clear upper dials only.

Step 5—With carriage in "1" position, set 295 on keyboard at 4th decimal. Depress plus bar once.

Step 6—Depress O clearance bar and lower shift bar simultaneously until carriage moves to the 3rd position. Push divide lever. The upper dials result, 5.90, is the percentage for Branch B. Clear upper dials only.

Step 7—Continue the same routine for C and D results. If correct divisors and dividends have been used in each case after the final division the lower dials will automatically clear to ciphers as proof.

RECIPROCALS

When the same divisor is used a number of times, division work can often be shortened by multiplying each dividend by the reciprocal of the divisor, according to the mathematical principle that dividing one number by another is the same as multiplying that number by the reciprocal of the divisor.

Definition of Reciprocal

The reciprocal of a number is the quotient of 1 divided by that number. For example, 1 divided by 5 equals .2; and therefore .2 is the reciprocal of 5.

Multiplying any number by .2 gives the same result that would be secured by dividing that number by 5 because 5 and .2 are reciprocals of each other.

Use of Reciprocals

Reciprocals are used extensively in arriving at percentages and in prorating work which will be described later. They also form the basis for the preparation of tables to shorten payroll calculations, insurance figuring, cost accounting, bond calculations, and many other kinds of mathematical work.

Reciprocals Commonly Used

The following are some common reciprocals used in different lines of business which, if they are to be used frequently, should be memorized.

Month of 28 days	.03571	144 (gross or inches to a square foot)	.006944
Month of 30 days	.03333		
Month of 31 days	.03226	240 pence to a pound	.004167
32 lbs. to a bushel	.03125	360 days to a year	.002778
60 lbs. to a bushel	.01667	365 days to a year	.002740
12 (dozen)	.08333	1728 cubic inches to a foot	.0005787
16 (ounces or 16ths)	.06250	5280 feet to a mile	.0001894

Tables of reciprocals from 1 to 10,000 are published but with the Monroe Adding-Calculator reciprocals can be secured so easily, due to the speed of division, in most cases tables are not required for general use.

Monroe Method for Finding Reciprocals

With the Monroe the finding of a reciprocal of any number is a simple problem in division.

Example To find reciprocal of 144, which is .006944

Method

Decimals: See Rules for Pointing Off Reciprocals which follow

Change Lever at ÷

Step 1—Move carriage to extreme right ("8" position with Model MA 7-173-W, "10" position with Model MA 7-213-W). Since the reciprocal of 144 is 1 divided by 144, prefix a 1 to 144 (1144) and set the 1144 on the extreme left of the keyboard. Depress plus bar once. Clear nothing. The machine now appears as in Figure 23.

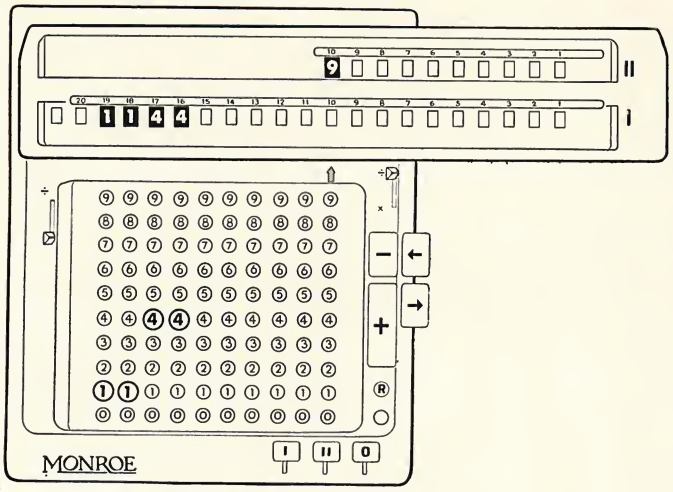

Figure 23

Step 2—With the zero column clear key on the extreme left-hand row of keys, clear the 1 in that column of the keyboard. Do not clear dials.

Step 3—Push divide lever. Note that on the first revolution of the machine the 144 is subtracted from the lower dials leaving only the 1 and the upper dials are cleared. In this case only 4 significant figures are required in the reciprocal so the automatic division should be stopped when it has been carried to 5 places. This is done by returning the divide lever to normal position when 5 of the upper dials are filled with figures. See Figure 24.

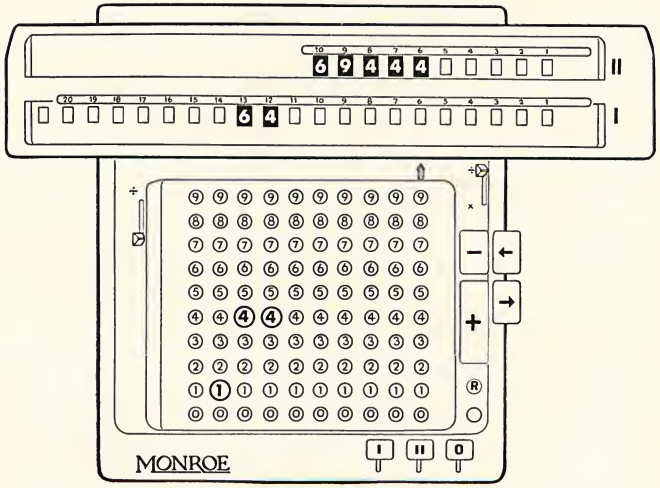

Figure 24

Step 4—The result in the upper dials is 69444, which will be the reciprocal when ciphers are prefixed and the decimal point determined according to the directions which follow.

Rule for Pointing Off Decimal Places in Finding Reciprocals

The reciprocal of any whole number or of a whole number and a decimal is always a decimal.

The reciprocal of any decimal is always a whole number or a whole number and a decimal.

As it is generally necessary to prefix ciphers to the quotient in the upper dials in order to place the decimal point correctly in the reciprocal, no decimal point is usually preset in the dials of the machine. For pointing off the decimal place in the reciprocal of either a whole number or a decimal the following simple rules should be followed.

Pointing Off Reciprocals of a Whole Number

Prefix as many ciphers to the reciprocal in the upper dials of the Monroe as there are whole numbers in the divisor, LESS 1.

To illustrate: in the preceding example, 144, having three whole numbers, requires the prefixing of two ciphers to the result. Thus the reciprocal of 144 is .006944.

Pointing Off Reciprocals of a Decimal

Point off as many whole numbers in the reciprocal in the upper dials of the Monroe as there are ciphers in the divisor, PLUS 1.

For example, in finding the reciprocal of .0457 the result in the upper dials, when carried to six places, is 218818; therefore, following the rule, the reciprocal of .0457 is 21.8818.

PRORATION OR DISTRIBUTION

To charge a total company expense to various departments, the amount of the total expense is distributed on the basis of some known factor, such as sales. The figure work involved is termed proration or distribution.

Example

Dept.	*Sales*	*Expense*
A	500	1500*
B	250	750*
C	750	2250*
Totals	1500	4500

In this example the amounts with an * are secured by prorating. The relationship of the total sales to the total expense is found by dividing the latter by the former. The result is 3. Then the sales figures of each department are multiplied by 3 which gives the prorated amount of expense for each department.

This type of figure work is very common to all business. The proration can be either a dollars and cents proration or it can be based upon percentage or a combination of both.

Example Railroad Proration

Division	*Mileage*	*Total Receipts*	*Due Each*	*Amount Due Each*
A	423		.526775*	$5101.684*
B	234		.291407*	2822.204*
C	146		.181818*	1760.862*
Totals	803*	$9684.75	1.000000	$9684.750

* *Calculated figures*

Method

Decimals: Upper Dials 0
Keyboard 8
Lower Dials 8
Change Lever at ×

Step 1—Add the mileages to secure the total mileage, 803.

Step 2—As previously described under Reciprocals, find the reciprocal for 803 which is .00124533.

Step 3—With the carriage in "1" position set .00124533 on the keyboard. Multiply by 423, mileage for Division A. Result in the lower dials is .52677459 or 52.6775% due Division A. Do not clear keyboard or dials.

Step 4—With the plus and minus bars change 423 in the upper dials to mileage for Division B, which is 234. The result is .291407.

Step 5—Continue same routine for Division C.

Step 6—Having secured the percentages it is necessary to prorate the total receipts, 9684.75, on the basis of these figures. Change machine set-up to: upper dials 6, keyboard 2, lower dials 8 decimals; change lever at ×.

Step 7—Set 9684.75 on keyboard and multiply by each percentage without clearing the dials or keyboard. Use the plus and minus bars to change the percentage multipliers. When finished be sure to add the results secured to check that they agree with the total. Sometimes it is necessary to adjust one or two cents so the amounts will add to the correct total.

If the percentages are not required but only the amounts due each Division, the reciprocal operation can be eliminated. The figure for the total receipts, 9684.75, is divided by the total mileage, 803. The result is 12.06071, receipts

per mile. Using this factor as a constant and multiplying by the mileage for each Division secures the amounts due each which will be the same as those secured by the percentage method of prorating.

COMBINED DIVISION AND MULTIPLICATION

Example $455.75 \div 625.34 = .72880 \times 45.75 = 33.3426$

Method

Decimals: Upper Dials 5
Keyboard 2
Lower Dials 7
Change Lever at $\times$

Step 1—With the carriage in the "6" position set 455.75 on right of keyboard. Depress plus bar once. Clear keyboard and upper dials.

Step 2—Set 625.34 on right of keyboard. Push divide lever. It will be noticed that as the divide lever is pushed the change lever automatically shifts into $\div$ position. At the completion of automatic division the quotient in the upper dials is .72880. Clear lower dials only. The keyboard should not be cleared at this point for that would return the change lever to the $\times$ position, which is not desired.

Step 3—Change keyboard set-up to 45.75. Move carriage to "2" position and multiply by the amount in upper dials, .7288. If the multiplication is correctly made the upper dials clear to zeros and the result in the lower dials is 33.3426.

DIALS TRANSFER MULTIPLICATION

In some types of work when one amount is multiplied by another and the result is then multiplied by a third amount, time can be saved by using what is called dials transfer multiplication.

Example $26 \times 136 \times 427 = 1509872$

Method

Decimals: None
Change Lever at $\times$

Step 1—With carriage in "1" position set 136 on right of keyboard. Multiply by 26. Result in lower dials is 3536.

Step 2—The result in the lower dials is now to be multiplied by 427. Instead of copying 3536 to the keyboard and subtracting to prove the keyboard set-up, leave the amount in the lower dials. Clear upper dials only.

Step 3—Move carriage to "4" position so that the first figure of the lower dials result, 3, is in direct alignment with the first right-hand row of keys.

Step 4—On the keyboard set the next multiplier, 427, LESS 1, or 426. The reason for dropping the 1 is that 3536 is already in the lower dials, which is the same as being multiplied by 1. Figure 25 shows the Monroe at this step.

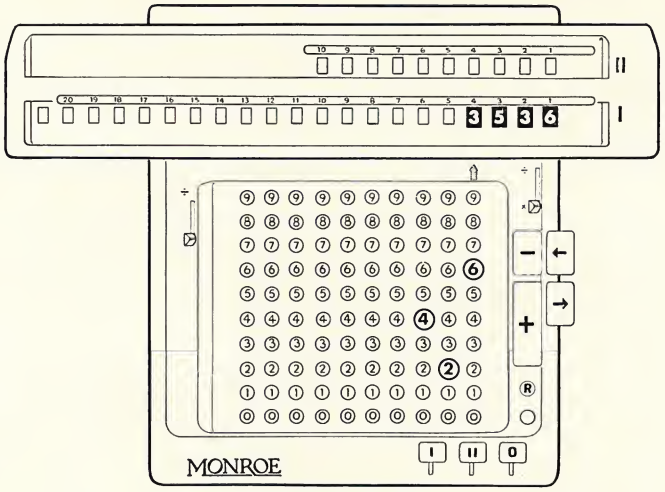

Figure 25

Step 5—Multiply by 3. Then move the carriage to the "3" position so that the figure 5 in the third lower dial is directly in line with the first right-hand row of keys. Multiply by 5.

Step 6—Continue to move the carriage to the left and multiply digit by digit until the upper dials read 3536, the multiplier which was in the lower dials. At the completion of the operation the machine reads as in Figure 26, with 509872, the final result in the lower dials.

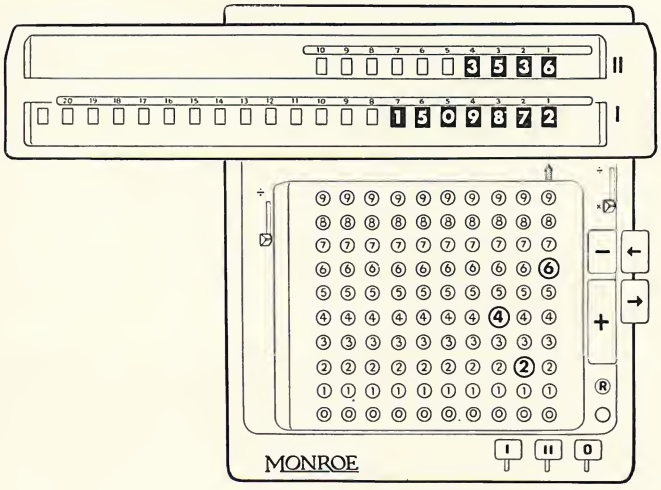

Figure 26

INTEREST

Interest can be figured by the ordinary arithmetical rule: multiply the principal by the rate, then multiply this result by the number of days and divide by 360 or 365 days in a year as required. The simple formula is as follows:

$$\frac{\text{Principal} \times \text{Rate} \times \text{Number of days}}{\text{Days in year}}$$

The Monroe Company has developed many shorter methods of computing interest, some of which make use of special interest tables or reciprocal factors. These tables and information about the methods will be furnished upon request by any local Monroe District or branch office.

One basic method which will be described here has the advantage that only one rate or factor is necessary regardless of the number of days or the amount of principal, provided all calculations are being made at the same rate; furthermore, no division is required and the dials transfer method of multiplication just described can be used.

Example Interest on \$3475 for 32 days at 1¾% is \$5.41

Method

Decimals: Upper Dials 3
Keyboard 6
Lower Dials 9
Change Lever at ×

Step 1—With carriage in "1" position set 3475 on right of keyboard and multiply by 32. The lower dials show the amount of principal for one day, 111200. Clear upper dials and keyboard only.

Step 2—Move carriage to "6" position. Set on keyboard .048611 which is the amount of interest for one day on \$1000, 360 day basis, secured from Monroe Interest Table, Form 456-S.

Step 3—By dials transfer method, multiply transferring the 111200 from the lower dials to the upper dials. Then the lower dials show the amount of interest, 5.41.

The decimal point was set at 3 in the upper dials because the interest rate is based on \$1000 and therefore three places should be pointed off in the one-day principal, 111.200.

BUILD-UP DIVISION

In certain types of work division is sometimes more easily and rapidly performed by using the build-up or additive method instead of the subtractive method that has already been described. It is especially efficient when a constant divisor or dividend is involved.

In this method the divisor is set on the keyboard and built up in the lower dials to the dividend amount by a series of additions performed by the plus bar. When the dividend has been built up in the lower dials the quotient automatically appears in the upper dials and all three factors are visible for proof.

Example $7955 \div 25 = 318.2$

Method

Decimals: Upper Dials 1
Keyboard 0
Lower Dials 1
Change Lever at $\times$

Step 1—Set 25 on right of keyboard. Move carriage to the "4" position so that 25, when added, will register in the lower dials in which the 79 of the dividend 7955 is to appear.

Step 2—With the plus bar add 25 until the lower dials show an amount as near as possible to 7955 without exceeding it. If four plus bar depressions are made the lower dials will show 10000.0 which exceeds 7955. Therefore three depressions should be made registering 3 in the upper dials and the lower dials read 7500.0.

Step 3—Move the carriage one place to the left into the "3" position and repeat the same operation with the plus bar. Only one depression can be made. The lower dials then read 7750.0 and the upper dials 310.0.

Step 4—Move the carriage to the "2" position and continue the plus bar operation. Eight machine revolutions are made and the lower dials show 7950.0.

Step 5—Move the carriage to the "1" position. When the plus bar is depressed twice the lower dials show the exact dividend, 7955.0, and the quotient, 318.2 is read in the upper dials.

In performing build-up division, if the divisor on the keyboard is correct then the moment when the exact dividend (or an amount as near to it as possible or just less) appears in the lower dials, the operator has positive proof that the quotient is correct.

SIMULTANEOUS MULTIPLICATION AND DIVISION

Build-up Method

A great deal of time can be saved by multiplying the quotient of a division at the same time the division is being made. Multiplication and division are performed simultaneously by building up the dividend in the right side of the lower dials at the same time the multiplier, set on the left of the keyboard, is being multiplied by the quotient. Two sets of decimal points are required on the keyboard.

For this type of work a Monroe with a ten column keyboard is recommended as the larger capacity is needed for double keyboard set-ups.

Example 1728 pieces @ $.26 per dozen = $37.44

Method

Decimals: Upper Dials 2
Keyboard 10-2
Lower Dials 12-2
Change Lever at ×

Step 1—Set 12, the number of pieces in a dozen, on the extreme right of the keyboard and .26 on the extreme left so that the keyboard reads .26000000.12.

Step 2—Move the carriage to "5" position so the 12 on the right of the keyboard will register in the lower dials in which the 17 of the dividend, 1728, will appear.

Step 3—Disregarding the left-hand side of the lower dials watch the right-hand side, building up the dividend, 1728, in that part of the dials.

Step 4—At the completion of the build-up division, all factors of the problem show in the Monroe as illustrated in Figure 27: lower dials at 2nd decimal, dividend, 1728; upper dials, 144, number of dozens in 1728; lower dials at 12th decimal, the result, 37.44.

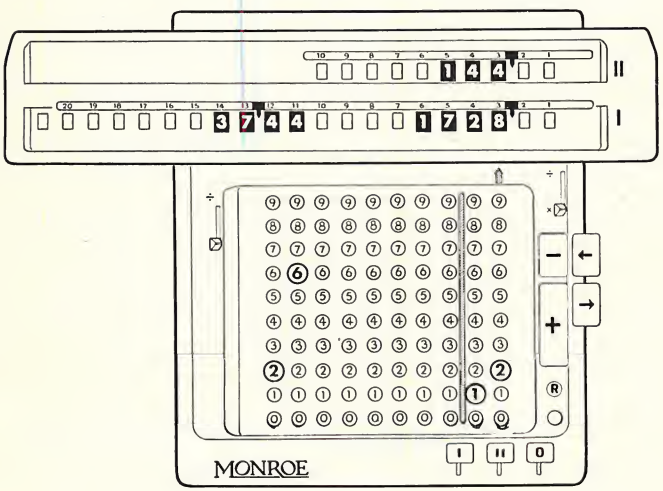

Figure 27

If the factors in a problem are too large for this method they can be handled by the complementary method.

Complementary Method

In the complementary method that is used when large numbers are involved, the division is performed subtractively by adding with the plus bar the complement of the divisor.

The dividend is added to the right side of the lower dials. The complement of the divisor is set on the right side of the keyboard, and the multiplicand, LESS 1, on the left side; all the 9 keys between these two keyboard set-ups are depressed to connect the two amounts. The reason for this keyboard set-up is that with each forward revolution of the machine a 1 is carried over from the dividend and the row of connecting 9's automatically carries it from digit to digit until it is finally added into the figures of the result of the multiplication on the left. Therefore to compensate for this extra 1 carry the 1 is dropped in the multiplicand.

Definition of a Complement

The complement of a number is the difference between it and the next higher power of 10. Thus the complement of 6 is 4; of 12 is 88; of 73 is 27; of 2142 is 7858, etc. A complement can be figured mentally by subtracting the right-hand digit from 10 and the other digits from 9. With the Monroe any complement can be found quickly by setting the amount on the keyboard and subtracting from ciphers in the lower dials with one depression of the minus bar; then the amount in the lower dials to the right of the 9's is the complement of the amount on the keyboard.

Example 1728 pieces @ $.26 per dozen = $37.44

Method

Decimals: Upper Dials 2
Keyboard 10-0
Lower Dials 12-2
Change Lever at ×

Step 1—With the carriage in the "3" position set 1728 on extreme right of keyboard. Depress plus bar once. Clear keyboard and upper dials only.

Step 2—On right-hand side of keyboard set 88, the complement of 12 (number of pieces in a dozen). On the left of the keyboard set .25 (price per dozen, .26 LESS 1). Connect these two amounts by depressing 9 keys so that the keyboard reads .2599999988.

Step 3—With carriage in "5" position depress plus bar once. The 17 in the lower dials has been divided by 12 once with a remainder of 5.

Step 4—Move carriage one place to the left. Depress plus bar until the 52 is less than 12. Lower dials at the right now read 48.00 and the upper dials 140.00.

Step 5—Move the carriage one place to the left and hold plus bar depressed for four revolutions. The right lower dials are now cleared. The Monroe, as shown in Figure 28, reads: upper dials 144, number of dozens in 1728 pieces; left lower dials at 12th decimal place, the result, 3744.

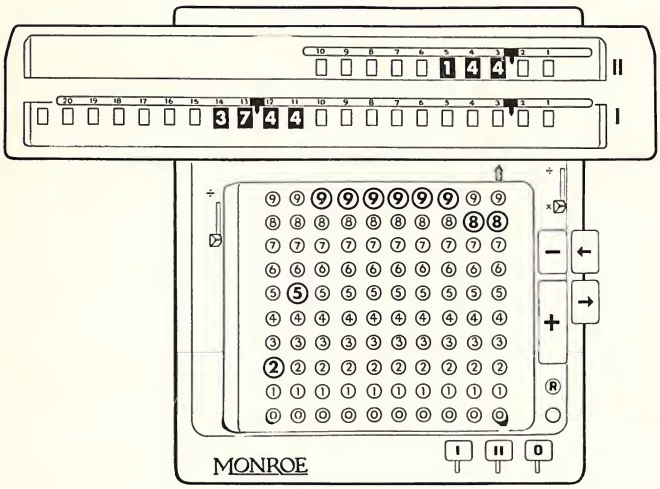

Figure 28

Automatic Positive Method

The following method also employing the complementary principle for simultaneous multiplication and division is faster and more automatic.

Example 1728 pieces @ $.26 per dozen = $37.44

Method

Decimals: Upper Dials 2
Keyboard 8-6-2
Lower Dials 10-4
Change Lever at ×

Step 1—With the carriage in the "5" position set 1728 on left of keyboard at 6th decimal. Depress the plus bar once. Clear keyboard and upper dials only.

Step 2—Set 11 on extreme left of keyboard (12 LESS 1) and .74 (complement of .26) on right. Connect the two factors by depressing 9's so that the keyboard set-up reads 11.99.9999.74.

Step 3—Push divide lever. At completion of automatic division the upper dials show 144.00, the number of dozens, and the lower dials, the result, 37.44.

Automatic Negative Method

If the figures are not too large this method is even faster than the previous automatic method because fewer keyboard set-ups are made.

Example 1728 pieces @ $.26 per dozen = $37.44

Method

Decimals: Upper Dials 2
Keyboard 8-6-2
Lower Dials 10-4
Change Lever at ×,
raised into locked position

Step 1—With carriage in the "5" position set 1728 on left of keyboard at 6th decimal. Depress minus bar once. Clear keyboard and upper dials.

Step 2—On the keyboard set 12 at extreme left and .26 at right.

Step 3—Hold plus bar down until machine locks. Then push automatic divide lever. Upper dials show 144, the number of dozens, and the lower dials 37.44, result.

MONROE TABLES AND SPECIAL INSTRUCTIONS

The Monroe Company publishes many interest and other decimal equivalent tables which further help to short-cut and simplify certain types of figuring jobs, also special instructions for applying the Monroe Adding-Calculator. These are furnished free to users and operators. Of the many Monroe publications, the few listed below are those most generally used in ordinary commercial figuring. Any that might be useful in your line of work will be gladly furnished by the nearest local office of the Monroe Calculating Machine Company, Inc., or by the main offices which are in Orange, New Jersey. Requests should mention form numbers.

Form No.	*Description*
117-S	Decimal Equivalents of Common Fractions—8ths to 64ths
118-S	Fractional Parts of a Gross
120-S	Chain Discount Equivalents
784-S	Chain Discount "Off" Equivalents
855-S	Chain Discount Reciprocal Equivalents
140-S	Tons Expressed as Pounds and Pounds as Decimal of a Ton
127-S	Days Between Dates—for prorata cancellations
159-S	Days as Decimal Equivalent of Year—365 Day Basis Reverse—Days Between Dates
160-S	Same—360 Day Basis
802-S	Same—366 Day Basis
359-S	Trigonometric Functions
360-S	Lumber Table
456-S	Interest on $1,000 for One Day, 1/16% to 12%—360 and 365 Day Basis
539-S	Same—366 Day Basis
662-S	Reciprocals of Interest on $1.00—1/16% to 10%—360 and 365 Day Basis
464-S	Conversion Factors, British-Metric-U. S. Systems
779-S	Table of British Currency
720-S	Monroe Method of Extracting Cube and Higher Roots
769-S	Monroe Method of Extracting Square Root

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